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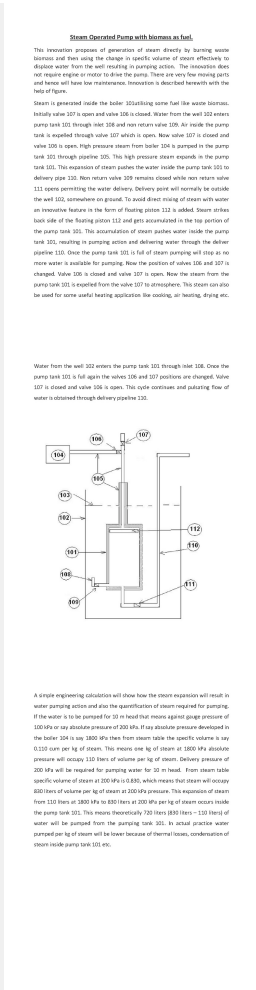
Steam Operated Pump with biomass as fuel

Pump vessel is submerged in well, steam pressure is used to pump water with intermittent flow.



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This innovation proposes of generation of steam directly by burning waste biomass and then using the change in specific volume of steam effectively to displace water from the well resulting in pumping action. The innovation does not require engine or motor to drive the pump. There are very few moving parts and hence will have low maintenance. Innovation is described herewith with the help of figure.

Steam is generated inside the boiler 101utilising some fuel like waste biomass. Initially valve 107 is open and valve 106 is closed. Water from the well 102 enters pump tank 101 through inlet 108 and non return valve 109. Air inside the pump tank is expelled through valve 107 which is open. Now valve 107 is closed and valve 106 is open. High pressure steam from boiler 104 is pumped in the pump tank 101 through pipeline 105. This high pressure steam expands in the pump tank 101. This expansion of steam pushes the water inside the pump tank 101 to delivery pipe 110. Non return valve 109 remains closed while non return valve 111 opens permitting the water delivery. Delivery point will normally be outside the well 102, somewhere on ground. To avoid direct mixing of steam with water an innovative feature in the form of floating piston 112 is added. Steam strikes back side of the floating piston 112 and gets accumulated in the top portion of the pump tank 101. This accumulation of steam pushes water inside the pump tank 102, resulting in pumping action and delivering water through the deliver pipeline 110. Once the pump tank 101 is full of steam pumping will stop as no more water is available for pumping. Now the position of valves 106 and 107 is changed. Valve 106 is closed and valve 107 is open. Now the steam from the pump tank 101 is expelled from the valve 107 to atmosphere. This steam can also be used for some useful heating application like cooking, air heating, drying etc.

Water from the well 102 enters the pump tank 101 through inlet 108. Once the pump tank 101 is full again the valves 106 and 107 positions are changed. Valve 107 is closed and valve 106 is open. This cycle continues and pulsating flow of water is obtained through delivery pipeline 110.

A simple engineering calculation will show how the steam expansion will result in water pumping action and also the quantification of steam required for pumping. If the water is to be pumped for 10 m head that means against gauge pressure of 100 kPa or say absolute pressure of 200 kPa. If say absolute pressure developed in the boiler 104 is say 1800 kPa then from steam table the specific volume is say 0.110 cum per kg of steam. This means one kg of steam at 1800 kPa absolute pressure will occupy 110 liters of volume per kg of steam. Delivery pressure of 200 kPa will be required for pumping water for 10 m head. From steam table specific volume of steam at 200 kPa is 0.830, which means that steam will occupy 830 liters of volume per kg of steam at 200 kPa pressure. This expansion of steam from 110 liters at 1800 kPa to 830 liters at 200 kPa per kg of steam occurs inside the pump tank 101. This means theoretically 720 liters (830 liters – 110 liters) of water will be pumped from the pumping tank 101. In actual practice water pumped per kg of steam will be lower because of thermal losses, condensation of steam inside pump tank 101 etc.

Solution

Steam is compressible and has different specific volumes. 1 kg of steam at 1800 kPa will occupy 110 liters while if pressure is reduced to 200 kPA the volume increases to 830 liters, which means it can displace 720 liters of water. This principle is used in the innovation. The submerged vessel in the tank gets filled with water by gravity and steam which is injected in the vessel pushes the water out because of expansion of steam. There are practically no moving parts in the system and hence it will be maintenance free.

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